button, which operation again earths the vertical line. VR is operated, and spring *r* making contact with *s* puts earth on the left-hand side of GM by way of switch-lever E (position 3). K also is operated by its upper coil, and the closing of its springs *e* and *d* brings the battery on the right-hand side of GM. The movement of GM's armature puts the generator (which is running continuously) on to the wipers, and thence to the required subscriber's (Z) loop, across which is placed his magneto bell, in series with a condenser. When Z replies, the current circulates through springs *e*, *f*, through the upper coil of J, round the loop, through J's lower coil, switch-lever F (position 3) to earth. J's two coils are now assisting each other, and spring *b* moves over to *c*. As *b* is joined to K's lower coil, this movement takes the battery from K's lower coil and puts on earth instead. The current now passes through K's upper coil, through VR, round A's loop, through RR and K's lower coil to earth *via c*. The currents in K, however, are opposing each other, so that the armature is not affected. The two subscribers are now "through," as in Fig. 6. The path traversed by the current on the left is shown by the dotted lines, and on the right by the heavy lines. The arrows through J and K show the direction through the separate coils, and the shading indicates the energised relays. The small skeleton diagram in Fig. 6 shows how the speaking circuit is made up. On Z's side the two coils

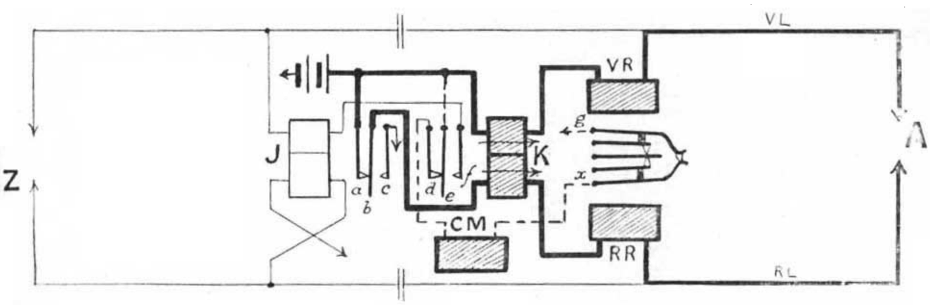

FIG. 7.—Clearing.

of J serve as impedance coils, whilst K's upper coil, plus VR and K's lower coil, plus RR, serve the same function on A's side.

On the conclusion of the conversation both subscribers hang up their receivers. In its passage downwards the switch-hook (momentarily) earths both the vertical and rotary lines simultaneously. The result of this action on A's part is that his rotary line is earthed at both ends. RR and the lower coil of K are thus short-circuited. K is then actuated by his upper coil, and by the movement of *e* from *f* to *d* current is cut off from J, which, ceasing to be energised, allows its armature to fall back. This causes *b* to leave *c* and return to *a*, substituting the battery for earth on the lower coil of K. Current now passes through both coils of K in the same direction, and thus continues to energise K, whilst both VR and RR being actuated, their outer springs make contact with each other and put earth on the right of the coils of CM, the clearing magnet. The other side of CM being connected with the battery through *d e*, the clearing magnet is energised. This is shown in Fig. 7, where the dotted line indicates the circuit of CM. The shaft is thus restored to its normal position and the circuits are cleared.

When a second caller attempts to get through to another subscriber who is already engaged, the following action takes place. As shown in Fig. 6 the earth on the left hand of J's lower coil is made by the lever F of side-switch in its third position. This puts earth on the "engaged" wiper, and through it on to all Z's contacts in the busy multiple. The new caller turns his disc twice in the usual way, thus getting on to Z's contacts in the line multiple. His (the newcomer's) side-switch, however, is still in position 2, so that, although his line wiper is on the required contacts, the wiper itself is still isolated. The final current over his rotary line causes RR and SM to be actuated. A contact on the latter (shown only in Fig. 3) is closed. The battery is already connected to the left hand of the newcomer's clearing magnet by means of his springs *d* and *e*. The closing of the contact on SM put the right-hand side of CM through to the earthed busy bank by way of lever F (position 2) of his own side-switch. His clearing magnet thus acts and his lever L returns to zero. By another contact (not shown) the busy signal from the generator is given over the newcomer's line, advising him that the required subscriber is engaged.

From the foregoing brief sketch it is hoped that the principle of working may be seen: the actual arrangements in practice involve large modification and extension. As only a certain percentage of the switches are in use at the same time, it is easily seen that it is unnecessary to provide one for every subscriber. A much simpler piece of apparatus, the "line switch," is therefore substituted, and only a comparatively small number of switches proper provided. The function of the first is simply to put a calling subscriber through to a disengaged switch—now slightly modified and called a "selector"—by which a certain group is selected. The subscriber having got through to the required group, now utilises a second switch, arranged practically as we have described and termed a "connector," through which he obtains access to the required correspondent. A still larger exchange will require a first selector, a second, &c., selector, and finally a connector. Taking the common case of an exchange with a maximum of 9999 subscribers: the line switch puts the caller through to a first selector, by which the thousands digit is selected. The hundreds figure is then picked out by the second selector, and the tens and units by the vertical and rotary movements of the connector.

ARTHUR CROTCH.

THE SUMMER OF 1911.

THE summer of 1911 has been remarkable in so many ways that without doubt it will receive the special attention of meteorologists, and will in course of time be dealt with very thoroughly, as it well deserves to be. Having for many years past kept touch with the published Greenwich weather records, a comparison of the present summer with the observations of the past seventy years, from 1841, may be of interest from one not officially attached to the Royal Observatory.

The exceptional character of June, July, and August lead naturally to the supposition that the summer proper, as limited to the three months, would beat all previous records in many ways, and this impression is amply supported by weather statistics.

The summer six months, April to September, can also claim a record so far as temperature is concerned. The mean temperature for the six months is

60·7°, which is the highest for any similar period since 1841. The next means are 60·6° in 1893, 60·4° in 1868, and 60·1° in 1865. These are the only summer six months with the mean temperature at Greenwich above 60°, and there has not been any summer with the mean temperature above 58° since 1901.

The following are the results for the several months:—

	Air Temperature			Rainfall		Sunshine
	Mean max.	Mean min.	Mean	Days	Total	Hours
	°	°	°		Inches	
April	55	39	47	13	1·75	150
May	69	47	58	9	1·88	212
June	71	51	61	12	2·11	224
July	81	56	68	3	0·26	335
Aug.	81	57	69	8	1·35	260
Sept.	72	50	61	8	1·34	234

The aggregate rainfall for the six summer months is 8·69 inches, which is more than 3·5 inches less than the average; there are several summers, comprised by the six months April to September as dry.

The mean temperature for the three summer months June, July, and August is 66·1°, which is 4·9° in excess of the average for the past seventy years; this is 1° warmer than any previous summer. The next warmest three summer months occurred in 1868, when the mean was 65·1°, and in both 1859 and 1899 the mean was 65·0°. August was the warmest summer month, the mean being 1° higher than in July.

The warmest days during the summer were as follows:—

Day	Temperature	Daily mean n excess of average
	°	°
July 21	94	15
,, 22	96	15
,, 28	92	14
Aug. 9	100	19
,, 13	91	14
Sept. 7	92	12
,, 8	94	13

There were in all during the summer seven days with a temperature above 90°, and the only other summer during the last seventy years with an equal number of warm days is 1868. In 1876 there were six days with the thermometer above 90°, whilst the only other years with as many as four such warm days were 1846, 1881, 1893, 1900, and 1906. There were forty-five days during the summer, from April to September, with the shade temperature at Greenwich above 80°, and previously the greatest number of such warm days was forty in 1868.

The absolute temperatures are very exceptional:—95·6° was recorded on July 22, which was the highest previously recorded at any period of the summer since 1841, with the exception of 97·1° on July 15, 1881, and 96·6° on July 22, 1868. The maximum reading of 100° at Greenwich on August 9 is 3° higher than any previous record at the Royal Observatory since 1841. On September 8 the shade temperature was 94·1°, which is higher than any previous reading in September, and the mean of the maximum readings from September 1 to 8 was warmer by 2° than the mean for any corresponding period since 1841. The mean maximum temperature for August is 81·1°, which is the first occasion of the mean of the highest day readings in August exceeding 80°.

The aggregate rainfall at Greenwich for June, July, and August is 3·72 inches, which is 2·80 inches less than the average. The only instances of a drier summer are 3·65 inches in 1849, 2·91 inches in 1869, and 2·50 inches in 1864. The driest month of the summer was July with 0·26 inch.

The periods of absolute drought were twenty-three days from July 1 to 23 and seventeen days from August 2 to 18.

There was an unusual amount of bright sunshine throughout the summer—the aggregate duration in the three months, June to August, was 819 hours, which is 189 hours more than the average for the last fifteen years.

The black-bulb thermometer exposed to the sun's rays exceeded 160° on July 22, August 4 and 9.

CHAS. HARDING.

A VULCANOLOGICAL INSTITUTE.

IN the *Nuova Antologia* of July 16, a copy of which has recently reached us, there is an interesting article by Mr. Immanuel Friedlander, in which he points out reasons which justify the attempt now being made to establish an International Vulcanological Institute. This is a matter to which we have already referred (see NATURE, April 6, 1911, p. 180). Among the many reasons why volcanoes should receive special attention is the fact that they bring to the surface fused silicates and other materials from the deeper parts of the crust of our earth which otherwise we should not be able to reach. Two lines of study are open to us. One is to investigate the phenomena presented by a given volcano, whilst the other is based upon the consideration of their geographical and geological distribution. In connection with this distribution we are told that the Atlantic and Pacific types of volcanoes differ in the chemical characters of their products. Attention is next directed to the fact that although many volcanoes follow faults or lines of weakness in the crust of the earth, examples are given of vents which seem to be independent of such lines.

The materials which have been erupted from selected volcanoes are enumerated in some detail. These fall under three heads, namely, materials which are Basaltic, Andesitic, and Trachitic, the quantities of silica in which are respectively 56, 60 and about 70 per cent. The volcanoes with the more acid lavas are the most irregular and violent in their activity. A curious feature connected with volcanic eruptions is that the nature of the material ejected is not necessarily constant. The first eruption from Panteleria was basaltic, after which materials which were andesitic together with acidic Liparites appeared. The last efforts at this island, like the first, revealed materials which are basic.

From the softening of glassware and the ignition of various materials, the temperature of the dust-cloud which was shot out laterally to destroy St. Pierre and its 30,000 inhabitants was estimated at about 600 or 800 degrees. The needle-like pinnacle which grew upwards from the crater of this mountain is compared with the one which in 1909 grew in the crater of Mount Tarumai in Yezo.

These, together with many other curious appearances and phenomena observed by the vulcanologist, suggest that much remains open for investigation.

One interesting section in the paper is a brief discussion of certain theories respecting the cause of volcanic action. It is pointed out that water could not pass to regions of heated rock through cracks or fissures. Suess considers that the aqueous vapour which escapes from volcanic vents represents water which reaches the surface of the earth for the first time, while Alfred Brun, of Geneva, denies the presence of water in volcanic eruptions. Stübel, who has worked amongst the volcanoes of Central America, holds the view that each volcano derives its materials from a special reservoir left in the crust